

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
NEW TECHNOLOGY AND RESEARCH

MINOR RESEARCH FINAL REPORT

Evaluation of Several Brands of Anaerobic Threadlocking Compounds
used for Various Bolting Applications

Study Supervised by:..... Wesley S. C. Lum, P.E.

Principal Investigator:..... Michael R. White, P.E.

Report Prepared by:..... Michael R. White, P.E., Robert J. Meline, P.E., and Jarvis Mahe

Research Work Performed by: Michael R. White, P.E., Glen N. Weldon, and Jarvis Mahe

Michael R. White, P.E.
Transportation Engineer (Civil)

Robert Meline, P.E.
Chief, Durability and Maintenance Engineering Branch
Office of Infrastructure Research

Wesley S. C. Lum, P.E.
Chief, Office of Infrastructure Research

1. REPORT NO. FHWA/CA/OR-2001/32	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE Evaluation of Several Brands of Anaerobic Threadlocking Compounds Used for Various Bolting Applications		5. REPORT DATE August 7, 2001	
		6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) Michael R. White, P.E., Robert J. Meline, P.E., and Jarvis Mahe		8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS California Department of Transportation New Technology & Research, MS#83 P.O. Box 942873 Sacramento, CA. 94273-0001		10. WORK UNIT NO.	
		11. CONTRACT OR GRANT NO.	
12. SPONSORING AGENCY NAME AND ADDRESS New Technology & Research, MS#83 P.O. Box 942873 Sacramento, CA. 94273-0001		13. TYPE OF REPORT & PERIOD COVERED Final	
		14. SPONSORING AGENCY CODE	
15. SUPPLEMENTARY NOTES This project was performed in cooperation with the U.S. Department of Transportation, Federal Highway Administration.			
16. ABSTRACT <p>Caltrans has various bolting applications using different diameter sizes and materials. In some cases an Anaerobic Threadlocking Compound is more suitable for securing the nut on a bolt. The 1999, Caltrans "List of Approved Threadlocking Compounds" refers to only 1" diameter hot-dipped galvanized threaded rods with a matching ASTM A563, Grade DH nuts. These results did not cover the various sizes and materials that could be used for Anaerobic Threadlocking Compounds.</p> <p>Caltrans tested five different anaerobic threadlocking products to various bolting applications. The tests were completed with different diameter bolts made from different types of materials to see if they would produce breaking torque and prevailing torque values that are similar to the values obtained in 1992. The tested products were manufactured by Loctite Pro-Lock Division, Permabond International, Hernon Manufacturing Inc., Saf-T-Lok, and Pacer Inc. All five of the anaerobic threadlocking compounds tested had a breaking torque higher than 70 N-m and a prevailing torque higher than 75 N-m. These results can only be assured if all traces of oil, debris, and dry lubricants are thoroughly removed from all threaded surfaces prior to application of the primer or adhesives.</p> <p>This study produced a list of threadlocking compounds that are approved for use only for each particular size and type. This list is part of the "Caltrans Pre-Qualified Product List" on the Internet at: http://www.dot.ca.gov/hq/esc/approved_products_list/</p>			
17. KEY WORDS threadlocking, anaerobic, threaded fasteners, cable restrainer		18. DISTRIBUTION STATEMENT No Restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161	
19. SECURITY CLASSIF. (OF THIS REPORT) Unclassified	20. SECURITY CLASSIF. (OF THIS PAGE) Unclassified	21. NO. OF PAGES 21	22. PRICE

NOTICE

The contents of this report reflect the views of the New Technology & Research Program, which is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

Neither the State of California nor the United States Government will endorse products or manufacturers. Trade or manufacturers' names appear herein only because they are considered essential in establishing the completeness and accuracy of this document.

Conversion Factors

Torque:

To convert Newton-meter (N·m) to pound· foot (lb·ft) multiply (N·m) by 0.7376.

To convert pound-foot (lb·ft) to Newton-meter (N·m) multiply (lb·ft) by 1.3558.

Note that both lb·ft and ft·lb are used as units of torque. Most torque wrenches are labeled with, or report results in, ft·lb. In the U.S customary system of units a moment of force (torque) should be reported as lb·ft while a force acting over a distance (work) is reported as ft·lb.

Temperature:

To convert degrees Celsius (°C) to degrees Fahrenheit (°F), multiply °C by 1.8 and add 32.

To convert degrees Fahrenheit (°F) to degrees Celsius (°C),
subtract 32 from °F and divide that result by 1.8.

Force:

To convert Newton (N) to pounds (lb) multiply (N) by 0.22481.

To convert pounds (lb) to Newton (N) multiply (lb) by 4.4482.

Length:

To convert meters (m) to feet (ft) multiply (m) by 3.2808.

To convert feet (ft) to meters (m) multiply (ft) by 0.3048.

To convert meters (m) to inches (in) multiply (m) by 39.3701.

To convert inches (in) to meters (m) multiply (in) by 0.0254.

RESEARCH STAFF

The Office of Infrastructure Research was responsible for conducting the tests, developing the list of approved threadlocking compounds, and writing the final report.

The project was completed under the supervision of:

T. Joseph Holland, P.E.

Senior Materials and Research Engineer

Caltrans, Office of Research

The Principal Investigator was:

Michael R. White, P.E.

Transportation Engineer (Civil)

Caltrans, Office of Infrastructure Research

The Secondary Investigator was:

Jarvis Mahe

Transportation Engineer (Civil)

Caltrans, Office of Infrastructure Research

The fastener and threadlocking compound consultant was:

John P. Dusel, Jr., P.E.

Senior Materials and Research Engineer

Caltrans, Office of Structural Materials

ACKNOWLEDGMENTS

This research was accomplished in cooperation with the United States Department of Transportation, Federal Highway Administration.

The authors wish to thank the following staff members of the Division of Materials Engineering and Testing Services, (METS), for their enthusiastic and competent support on this project:

Testing

Glen Weldon

Machine Shop

Gene Weyel, Mike Said, Bill Poroshin, and Jesse Perez

TABLE OF CONTENTS

TOPIC	PAGE
Technical Report Standard Title Page	ii
Disclaimer	iii
Metric Conversion Information	iv
Research Staff and Acknowledgements.....	v
Table of Contents.....	vi
List of Tables	vii
List of Figures	vii
 1. INTRODUCTION	 1-2
1.1 Overview of Report Contents.....	1
1.2 Problem Statement.....	1
1.3 Background.....	1
1.4 Literature Search	1
1.5 Objective and Scope	1-2
1.6 Benefits	2
 2. TECHNICAL DISCUSSION	 2-9
2.1 Products.....	2-3
2.2 Test Facility.....	3
2.3 Test Equipment.....	3
2.4 Specimen Preparation.....	3-6
2.4.1 Clean Threads	6
2.4.2 Prime Threads	6
2.4.3 Bond Threads.....	6
2.4.4 Adjust Nut.....	6
2.5 Test Method.....	7
2.6 Test Results	7-8
2.7 Evaluation.....	9
 3. CONCLUSIONS and RECOMMENDATIONS	 9
3.1 Future Research.....	9
 4. IMPLEMENTATION	 9-10
4.1 Short Term.....	9
4.2 Long Term.....	9-10
 6. REFERENCES	 10
 5. APPENDICES	 10
A Pre-Qualified Products List Website	A1-A2
B Approved Systems	B1

C Application Instructions.....C1

LIST OF TABLES – TEST RESULTS

TABLE	PAGE
1. Test Series 1, 1-1/2"x4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension.....	7
2. Test Series 2, 1" x 4" long A325 plain bolts with matching A194 Grade 2H nuts.....	7
3. Test Series 3, 7/8" – 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolts with matching A194 Grade 8 (Type 304 SS) Heavy Hex nuts.....	8
4. Test Series 4, 1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts.....	8
5. Test Series 5, 1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts.....	8

LIST OF FIGURES

FIGURE	PAGE
1. Five different Anaerobic Threadlocking Compounds	2
2. 1-1/2"x4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension.....	4
3. 1" x 4" long A325 plain bolts with matching A194 Grade 2H nuts	4
4. 7/8" – 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolts with matching A194 Grade 8 (Type 304 SS) Heavy Hex nuts.....	5
5. 1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts	5
6. 1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts	6

1. INTRODUCTION

Caltrans uses various bolting applications for many bridge structures to limit longitudinal displacement during seismic events. These structures are secured to the bridge with a single nut near each end of this threaded bolt or rod section. The nut is not tightened against the structure, but is secured on the threaded bolt with an anaerobic threadlocking compound. In 1992 and 1999 a series of tests were performed on anaerobic threadlocking compounds applied to a 1" diameter ASTM A449 hot-dipped galvanized threaded rod with a matching ASTM A563, Grade DH nut. The results produced a list of Caltrans approved anaerobic threadlocking compounds from which cable manufacturers could use as a source list for that specific size and type of material.

1.1 Overview of Report Contents

This report describes the problems related to the lack of tests performed for different diameter sizes and different types of materials using the anaerobic threadlocking compound for various bolting applications. The report also lists the products that were tested in hopes of producing a list for use by the manufacturer(s). These products were tested on representative samples for various bolting applications of different diameter bolt sizes and different materials. Those that provided an acceptable level of breaking torque were then approved. The results of the testing are described herein and will become posted on the Caltrans Website under the Qualified Products List (QPL). This report also makes recommendations that may be incorporated into future Caltrans Standard Specifications.

1.2 Problem Statement

A list is needed for approved anaerobic threadlocking compounds for various bolting applications on bridge structures, using different diameters bolts and different types of materials.

1.3 Background

After the results of the 1999 Anaerobic Threadlocking Compound for a 1" diameter ASTM A449 hot-dipped galvanized threaded rod with a matching ASTM A563, Grade DH nut, maintenance crews were requesting new tests be made for various bolting applications with different diameter bolt sizes and made from different types of materials using the anaerobic threadlocking compound. The original scope of this project was based on a request by the Structures Representatives on the Benicia-Martinez Bridge. The first request was only for the ASTM Designation A325 Plain bolts in blind tapped holes in steel plates. After the project was approved and funding was set, the same Representative discovered other bolting situations on the same structure that required the use of threadlocking compounds. It was requested that the scope of the original project be expanded to allow inclusion of these other bolting applications.

1.4 Literature Search

A literature search was not deemed necessary due to the simple nature of the proposed testing and the time constraints involved.

1.5 Objective and Scope

The objective of this minor research project was to produce a list of approved anaerobic threadlocking compounds for various bolting applications. This was accomplished by evaluating the performance of several anaerobic threadlocking compounds. These compounds were tested to see if they could provide a breaking torque similar to or higher than those obtained in the testing done in

1992. The breaking torque value used in the 1992 tests was used as a base value for these tests because there have not been any significant problems with the nuts migrating under normal service conditions.

1.6 Benefits

The main benefit of this research was to provide a list of approved anaerobic threadlocking compounds for use by designers and crews of various bolting applications. Information gathered might also be useful in other areas where Caltrans has the need to secure nuts onto threaded bolts or rods. It is important to note that this information applies only to the same type and size of threaded bolts.

Warning: Care must be taken to ensure that the resulting list of approved anaerobic threadlocking compounds is not used in applications that are significantly different from those tested here. The breaking torque expected in this research project may vary significantly from other types of fasteners based on variables such as; lubrication, nut-to-rod clearances, finishes such as galvanized or plain, or non-finished stainless steels, and whether or not the nut (or bolt) is torqued against a positive stop.

2. TECHNICAL DISCUSSION

2.1 Products

Caltrans purchased five different anaerobic threadlocking compounds from their respective vendors, as shown in Figure-1.

Figure-1 Five different Anaerobic Threadlocking Compounds.

These products are:

1. Loctite Pro-Lock Division

- a) Loctite 7070 Cleaner. Part No. 22355
- b) Pro-Lock “Klean-N-Prime.” Part No. 30566
- c) Pro-Lock High Strength Threadlocker. Part No. 81792

2. Permabond International

- a) Perma-Lok Anaerobic Surface Conditioner. Part No. ASC10
- b) Perma-Lok Heavy Duty Bolt and Stud Locking Anaerobic Adhesive/Sealant. Part No. HH120

3. Hernon Manufacturing, Inc.

- a) Hernon Cleaner. Part No. EF-62
- b) Hernon Primer. Part No. EF-49
- c) Hernon Nuts N’ Bolts Anaerobic Adhesive. Part No. 429

4. Saf-T-Lok

- a) Primer T. Part No. 19166
- b) T77 High Strength Anaerobic Adhesive. Part No. 27741

5. Hernon Manufacturing, Inc.

- a) Primer. Part No. 580-031
- b) ANL-77 Anaerobic Adhesive. Part No. 560-073

2.2 Test Facility

All testing related to this research project were conducted at the Transportation Laboratory (Translab) of the California Department of Transportation in Sacramento, California.

2.3 Test Equipment

The torque required to break the nuts free was applied using a Mitutoyo brand digital torque wrench with a range of 0 to 340 N·m.

2.4 Specimen Preparation

Five Test series were performed with different bolting methods, different diameter sizes, and different types of materials as listed below.

Test series 1, consisted of 1-1/2"x4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension as shown in Figure-2.

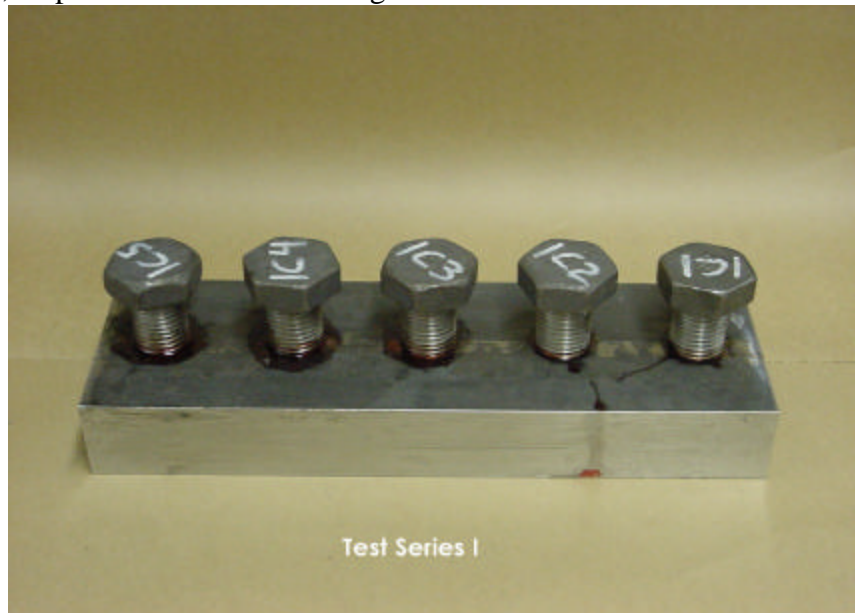


Figure-2 1-1/2"x 4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension.

Test series 2, consisted of 1" x 4" long A325 plain bolts with matching A194 Grade 2H nuts as shown in Figure-3 below.



Figure-3 1" x 4" long A325 plain bolts with matching A194 Grade 2H nuts

Test series 3, consisted of 7/8" – 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolts with matching A194 Grade 8 (Type 304 SS) Heavy Hex nuts as shown in Figure-4 below.



Figure-4 7/8" – 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolts with matching A194 Grade 8 (Type 304 SS) Heavy Hex nuts

Test series 4, consisted of 1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts as shown in Figure-5 below.



Figure-5 1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts

Test series 5, consisted of 1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts as shown in Figure-6 below.



Figure-6 1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts

For each test series, five specimens were assembled for each of the five different threadlocking compounds. The following instructions were used to secure the nut onto the threaded bolt. In the event of conflict between these instructions and those of a manufacturer, the manufacturer's instructions take precedence.

2.4.1 Clean Threads

Clean bolt and nut threads using the cleaning agent supplied with the corresponding threadlocking compound or with acetone. Use a small wire brush to remove all traces of oil and debris from the threads of both the bolt and nut.

2.4.2 Prime Threads

Apply the primer (supplied by the thread locker manufacturer per the provided instructions) to the threads of both the bolt and the nut.

2.4.3 Bond Threads

Apply the threadlocker compound per the instructions provided by the manufacturer onto the bolt and nut threads.

2.4.4 Adjust Nut

Thread the nut onto the bolt to the desired location by turning in one full turn and then backing it out one-half turn. Continue this procedure until the nut is at the desired final location on the bolt. This will ensure complete coverage of the threads.

2.5 Test Method

The test method used to evaluate these threadlocking compounds is very similar to that contained in ASTM D5649-94 "Standard Test Method for Torque Strength of Adhesives used on Threaded Fasteners." The minor deviations involved do not affect or invalidate the results.

To simulate curing conditions in the field, the assembled test specimens were supported at the ends and placed in a horizontal position so the nuts were not supported. These assemblies were then allowed to cure for 48 hours. After the curing period, the maximum torque required to initiate unseating movement of the nut on the threaded rod was recorded with either a dial or digital torque wrench (click type torque wrenches cannot be used for this testing). This number was recorded as the "breaking torque." Another torque reading was taken as the nut was rotated through 180 degrees and this number was recorded as the "prevailing torque."

2.6 Test Results

All five of the tested anaerobic threadlocking compound brands had an average breaking torque that was higher than the desired 45 lb-ft when the nut is properly cleaned of all traces of the dry lubricant applied by the nut manufacturer. The specific results for each manufacturer are listed in Table-1 through Table-5, below.

Table-1. Test results for Test Series 1.

1-1/2" x 4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension.

Manufacturer	Breaking Torque						Prevailing Torque					
	Sample No.						Sample No.					
	1	2	3	4	5	Avg	1	2	3	4	5	Avg
Loctite Pro-Lock Division	X	X	X	X	X	X	ND	ND	ND	ND	ND	
Permabond International	X	X	X	X	X	X	ND	ND	ND	ND	ND	
Hernon Manufacturing, Inc.	X	X	X	X	X	X	ND	ND	ND	ND	ND	
Saf T Lok	X	X	X	X	X	X	ND	ND	ND	ND	ND	
Pacer	X	X	X	X	X	X	ND	ND	ND	ND	ND	

X = exceeded the 1000 lb-ft capacity of the available torque wrench being used.

ND = Not Done

Table-2. Test results for Test Series 2.

1" x 4" long A325 plain bolt with matching A194 Grade 2H nut.

Manufacturer	Breaking Torque						Prevailing Torque					
	Sample No.						Sample No.					
	1	2	3	4	5	Avg	1	2	3	4	5	Avg
Loctite Pro-Lock Division	650	640	730	640	640	660	307	426	531	609	519	478
Permabond International	642	430	640	530	460	540	419	320	415	433	446	407
Hernon Manufacturing, Inc.	380	440	490	350	520	436	520	457	396	263	454	418
Saf T Lok	500	530	506	510	523	514	352	323	323	330	371	340
Pacer	250	170	180	180	170	190	335	564	388	NC	419	427

Table-3. Test results for Test Series 3.

7/8"- 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolt with matching
A194 Grade 8 (Type 304 SS) Heavy Hex nut.

Manufacturer	Breaking Torque						Prevailing Torque					
	Sample No.						Sample No.					
	1	2	3	4	5	Avg	1	2	3	4	5	Avg
Loctite Pro-Lock Division	210	210	210	190	190	202	250	310	175	140	170	209
Permabond International	90	90	120	90	80	94	400	320	340	275	210	309
Hernon Manufacturing, Inc.	210	200	210	180	230	206	240	160	200	240	250	218
Saf T Lok	140	110	160	110	140	132	310	370	310	330	390	342
Pacer	50	20	20	30	80	40	290	380	160	330	200	272

Table-4. Test results for Test Series 4.

1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts.

Manufacturer	Breaking Torque						Prevailing Torque					
	Sample No.						Sample No.					
	1	2	3	4	5	Avg	1	2	3	4	5	Avg
Loctite Pro-Lock Division	x	x	x	x	x		DD	ND	ND	ND	ND	
Permabond International	472	290	350	100	275	297	x	x	x	784	x	
Hernon Manufacturing, Inc.	x	x	x	ND	ND		ND	ND	ND	ND	ND	
Saf T Lok	507	340	390	419	250	381	x	x	x	x	x	
Pacer	490	510	633	650	350	527	x	x	x	x	x	

X = exceeded the 1000 lb-ft capacity of the available torques wrench being used.

ND = Not Done

DD = Difficult to Determine

Table-5. Test results for Test Series 5.
1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts.

Manufacturer	Breaking Torque						Prevailing Torque					
	Sample No.						Sample No.					
	1	2	3	4	5	Avg	1	2	3	4	5	Avg
Loctite Pro-Lock Division	580	680	587	610	810	653	390	443	383	429	559	441
Permabond International	380	350	272	404	175	316	202	300	274	282	279	267
Hernon Manufacturing, Inc.	370	409	650	500	650	516	370	204	261	283	235	271
Saf T Lok	550	220	220	410	350	350	358	204	223	218	274	255
Pacer	250	350	250	290	550	338	277	218	230	171	242	228

2.7 Evaluation

All five of the anaerobic threadlocking compounds tested had average breaking torque and prevailing torque values that were acceptable. These results can only be assured if all traces of oils, debris, and dry lubricants are thoroughly removed from all threaded surfaces prior to application of the primer or adhesives.

3. CONCLUSIONS and RECOMMENDATIONS

The five brands of anaerobic threadlocking compounds tested should provide breaking and prevailing torque values high enough to prevent the nut from becoming loose on the threaded bolt or migrating.

The following recommendations are made as a result of the this project:

1. The information pertaining to threadlocking compounds contained under the Qualified Products List section of the above mentioned Caltrans website should be maintained and updated as the need arises.
2. The list of approved threadlocking compounds should be made available to the current (and future) cable restrainer manufacturer as well as made available to anyone through the Caltrans website.
3. The contents of Appendix A should be submitted to the Caltrans Specifications Unit for possible inclusion in the current SSP as well as incorporation into the next Standard Specifications.

3.1 Future Research

Designers and crews may still have different diameters and different materials to be investigated with the use of an anaerobic threadlocking compound for bolting applications. With the results of this test, designers and crews may consider this type of threadlocking procedure for bolting applications.

Caltrans has experienced corrosion problems when these cable restrainer units are used near bodies of salt water. However, Caltrans has undertaken steps to protect the main body of the cable. Further research should be conducted as soon as possible on the ability of these threadlocking compounds to effectively seal and prevent corrosion within the threadlocked area.

4. IMPLEMENTATION

4.1 Short Term

A list of approved threadlocking compounds and an installation procedure were developed from the results of this project and are included here as Appendix A. This same information was made available to designers and crews for immediate use for the specified bolting application. This information was also placed on the Caltrans website as part of the Pre-Qualified Products List (QPL) at:

http://www.dot.ca.gov/hq/esc/approved_products_list/threadlock.html.

4.2 Long Term

The nuts supplied with the cable restrainer units are manufactured to ASTM Designation A563, which requires that the nut manufacturer provide them with a lubricant, which is "clean and dry to the touch." This lubricant is intended for applications in which the nut is tightened onto the rod and torque down against some positive stop (as in a structural fastening application). When used for this cable restrainer application, the nut is not torqued down but is positioned on the threaded rod away from any positive stop. As such, the lubrication is not required and must be completely removed in order for the threadlocking compounds to achieve the desired breaking torque. It is best if this task is performed in a shop environment rather than in the field in order to reduce crew, or contractor, exposure to hazardous traffic conditions.

5. REFERENCES

1. *Standard Specifications*, California Department of Transportation, July 1999.
2. *Standard Specification for Quenched and Tempered Steel Bolts and Studs*, ASTM A 449-93. 1996 Annual Book of ASTM Standards, Volume 15.08, American Society for Testing and Materials, Philadelphia, 1996.
3. *Standard Specification for Carbon and Alloy Steel Nuts*, ASTM A 563-94. 1996 Annual Book of ASTM Standards, Volume 15.08, American Society for Testing and Materials, Philadelphia, 1996.
4. *Standard Test Method for Torque Strength of Adhesives Used on Threaded Fasteners*, ASTM D5649-94. 1995 Annual Book of ASTM Standards, Volume 15.06, American Society for Testing and Materials, Philadelphia, 1995.

6. APPENDICES

- A Pre-Qualified products list website
- B Approved Systems
- C Application Instructions

Appendix A

Caltrans Approved Threadlocking Systems to be used only for those particular size and material type.

This 3 page document lists the Caltrans approved threadlocking products as well as installation instructions and is intended to be updated on the current approved list. This information should either be incorporated directly into the latest Standard Special Provision (SSP), 75-610_B09-21-99 or the web address mentioned below should be listed in the SSP.

The most recent version of this information will be maintained on the Qualified Products List (QPL) on the Caltrans Website. The address for the QPL is:

http://www.dot.ca.gov/hq/esc/approved_products_list/

Once there, click on the hypertext, which reads "Restrainer Cable Threadlocking Compounds."

CALTRANS-APPROVED
ANAEROBIC THREADLOCKING SYSTEMS

When required, one of the following approved chemical anaerobic threadlocking systems shall be used for any of the following:

1. 1-1/2"x 4" long A325 plain bolts in 2" deep tapped holes in a 2-1/2" thick steel plate, no pre-tension,
2. 1" x 4" long A325 plain bolts with matching A194 Grade 2H nuts,
3. 7/8" – 9 UNC x 4" long A193 Grade B8 (Type 304 SS) plain bolts with matching A194 Grade 8 (Type 304 SS) Heavy Hex nuts,
4. 1-1/2" A325 plain bolts with matching A194, Grade 2H, plain nuts,
5. 1-1/4" A325, Type 1, HDG bolts with matching A563, Grade DH, HDG nuts.

These systems have been tested and approved for use only for those of specific type and size.

Other applications may require different components and application procedures. Consult Jarvis Mahe at (916) 227-7076 if you wish to use these products for applications other than that stated above.

Each of these Caltrans-approved anaerobic threadlocking systems has three required components:

- 1) **CLEANER** - to clean lubricant and oils from the threads of the stud and nut.
- 2) **PRIMER** - to promote rapid curing of the anaerobic compound and to minimize migration of compound on threads.
- 3) **ANAEROBIC THREADLOCKER ADHESIVE** - to secure nut onto stud by filling the gap between nut and stud threads. Note: Anaerobic threadlocker adhesive compounds will set only where no oxygen is available.

Appendix B

**TABLE 1.
APPROVED ANAEROBIC THREADLOCKING SYSTEMS**

Manufacturer Information	Component	Trade Name	Part No.
1. Loctite Pro-Lock Division 1001 Trout Brook Crossing Rock Hill, CT 06067-3910 (800) 562-8483 www.loctite.com	Cleaner	ODC-Free Cleaner & Degreaser (Formerly 7070 cleaner)	22355
	Primer	Pro-Lock “Klean-N-Prime”	30566
	Adhesive	Pro-Lock High Strength Threadlocker	81792
2. Permabond International 480 South Dean Street Englewood, NJ 07631 (800) 370-9647 www.permabond.com	Cleaner & Primer	Perma-Lok Anaerobic Surface Conditioner	ASC10
	Adhesive	Perma-Lok Heavy Duty Bolt and Stud Locking Anaerobic Adhesive/Sealant	HH120
3. Hernon Manufacturing, Inc. 121 Tech Drive Sanford, FL 32771 (800) 527-0004 www.hernonmfg.com	Cleaner	Hernon Cleaner	EF-62
	Primer	Hernon Primer	EF-49
	Adhesive	Hernon Nuts N’ Bolts Anaerobic Adhesive	429
4. Saf-T-Lok 300 Eisenhower Lane North Lombard, IL 60148 (630) 495-2001 www.saftlok.com	Cleaner	Non Specified	-----
	Primer	Primer T	19166
	Adhesive	T77 High strength Anaerobic Adhesive	27741
5. Pacer 7001 Ardmore Avenue Fort Wayne, IN 46809 www.crosslink-tech.com	Cleaner	Non Specified	-----
	Primer	Primer	580-031
	Adhesive	ANL-77 Anaerobic Adhesive	560-073

All components used in a single threadlocking application shall be from one of the systems above and from the same threadlocking adhesive manufacturer.

Note: Refer to the Application Instructions.

Appendix C

Application Instructions for Caltrans-approved Anaerobic Threadlocking Systems:

The following application instructions shall be used for all Caltrans-approved anaerobic threadlocker systems previously listed. In the event of conflict between application instructions stated here and those of a manufacturer, the manufacturer's instructions shall take precedence.

The following 4-step application procedure shall be used for anaerobic threadlocker systems:

- 1) **Clean Threads;** Brush or spray the required cleaner/solvent onto both nut threads and stud threads at the desired final nut location to remove any lubricants; use only in a well-ventilated area. Scrub nut threads thoroughly using a small wire brush. Remove all traces of the dry lubricant from the internal threads of the nut. Allow the cleaner to completely evaporate before applying primer. Wait the required drying time as recommended by the threadlocker manufacturer.
- 2) **Prime Threads;** Apply primer liberally onto cleaned threads of both the stud (only in area where nut will be positioned) and the nut. Wait briefly until threads appear dry.
- 3) **Bond Threads;** Apply the anaerobic compound liberally onto the stud threads according to the instructions provided by the manufacturer. Coat only in the threaded area where the primer was applied (the final desired position to be occupied by the nut).
- 4) **Adjust Nut;** Thread the nut onto the rod until it contacts the threadlocking compound. Then install the nut by turning it in one full turn and then backing it off one-half turn to evenly distribute the adhesive. Continue this procedure until the nut is one complete turn past the desired final location. Place a small bead of threadlocker compound around the outboard side of the nut/rod interface. Then slowly back the nut up one complete turn to the final desired position. This procedure will ensure even distribution of the adhesive on the rod threads and seal any thread gap at the ends.

Basic Performance Requirements: To be acceptable for securing nuts on bridge joint cable restrainer units: approved threadlocker systems shall achieve a minimum breaking torque* of 45 ft. lbs. when installed according to the above directions (or the manufacturer's recommended installation instructions) and cured for a minimum of 48 hours.

*Breaking torque is the initial torque required to cause the nut to begin to move on the threaded rod after the adhesive has fully cured. It is measured using a dial or digital (not click type) torque wrench, at the point the nut first begins to move relative to the threaded rod, while attempting to move/turn the nut in the direction that will unseat the nut.

Note: Refer to Table 1 for a listing of Caltrans-approved anaerobic threadlocking components.